Drugs effects on the central nervous system. Forensic implications

Daniel Popescu¹²*, Gabriela Popescu², George Lupu², Victor Panus², Sebastian Neagu-Sadoveanu³, Octavian Buda⁴

Abstract: Addiction is a widespread term used in our days. Some of the habits due to routine conditioning are called dependences, i.e.: eating shopping etc. These are fundamentally different of those due to chronic alcohol intake, drugs medicines (chemicals), with euphoric effect. For this reason some physicians prefer the term of addiction to drug. Unlike the benign addiction, by conditioning, drugs addiction initiates very fast (after 1 or 2 intakes), had a big resistance at treatment and show the phenomena of sever disturbance in withdrawal. In this paper we refer mainly at this kind of dependency. Nervous disturbances that are produced during drugs and even alcohol intakes refer to psychical affective and cognitive processes. The prevailing factor of these processes is the hedonist one.

Key words: Addiction, Neural mechanisms, Forensic evaluation

Psychic processes are due to activities of complex organized nervous structures in information processing systems. They are in a complex process of relations that form in the end the personality of human been.

We try to analyze drugs effects on different nervous structures. Affective moods are due to some nervous structures that make up the so called Limbic system. It is formed by different nervous units whose concentrated connections are positioned at hypothalamus level that forms the core of the vegetative-endocrine-somatic relation.

Cortical contributions of these structures are in the pre-frontal zones, gurus Cingular, and some temporal zones, forming the final stage of psychic processes of emotions.

In addition to these are the cognitive contributions resulting from the activities of the other cerebral areas. Very important for cerebral activities are connections with structures placed in the so called reticulate matter at brainstem level [1, 2, 3].

Some structures at this level have very important functional relations for the whole cortical-sub cortical activities. They are represented by nuclei origin groups of substances with neural-transmitters (NT) role (that work as real pace-makers for structures they are connected with). The
whole cerebral activity is dominated by systems where interneuronal connections are provided by neural-transmitters or neural-modulaters (NM).

Some researchers consider that NT group is made by acetylcholine (ACh), dopamine (DA), serotonin (5-HT), nor-adrenalin (NA) and aminobutiric acid (GABA). Remaining substances that have a role in nervous transmission are considered as neurotransmitters or neuro-modulators (NM).

**Drugs effects on nervous system**

Alcohol and especially drugs income produce structure changes that regard some nuclei groups and important nervous paths. The changes produced regard mainly genetically processes that contribute to the functional ensemble.

The protein synthesis of cellular enzymatic structural components or of receptors changes. An enhance of neuronal excitability at heroine consumers is observed in both dopamine and noradrenalin cases. During withdrawal the noradrenalin excess is the cause of big neural-vegetative and behavioral disturbance. At brainstem neurons level (central tegumentary area) and at the level of accumbence nucleus or prefrontal changes take place. Endorphin interaction with TA or NA neurons is also important. This is the case of: locus coeruleus nuclei level or the effects at limbic system and hypothalamus level and the effects of heroin on DA or GABAergic neurons form the ventral tegmentary area.

Heroin lowers the endorphin level and thus during withdrawal the NA hyperactivity is installed [4,5,6].

Receptors that respond at opioid and canabinoid like substances, exist at ventral thalamic nucleus level that stimulate the dopamine transmission. In this way the pleasure effect that appears during ingestion of different drugs is explained. Methadone has a longer action period and a weaker effect on processes that produce addiction and they are a primary action mean in detoxification treatment purpose. We highlight the fact (experimentally proven) that part of dopaminergic system is involved in the so called reward-pleasure system.

**Fig. 1.** Lower relative glucose metabolism in the prefrontal cortex and anterior cingulate gyrus of a cocaine abuser than in a normal comparison subject

**Fig. 2.** Lower striatal dopamine D2 receptor binding in drug users during withdrawal from cocaine, methamphetamine, and alcohol than in normal comparison subjects
In the case of psycho-stimulant (amphetamine, ecstasy) the pathologic process refers to the receipting mechanisms of NT, while in the case of opioids (and derivatives) a special sensibility of endophyne or cannabinoids (the case of marijuana) receptors takes place.

Drugs effects can be structured as follows:

**Psychic disturbance in drugs addiction**

Despite the fact that in the case of behavioral disturbances exist various similarities between the big alcohol consumers and those that use drugs, the changes produces at brain level are different. In the case of chronic ethylic lesions regard both mammillae bodies (like in Wernicke psychosis) and other nervous structures completely different of those that are produced in drug addiction.

In this last case we find structural disturbances that regard different structures of limbic systems, nuclei from brain stem, accumbeus nucleus or pre-frontal and cingular cortex with effect mainly on the hypothalamus-hypophysis-somatic axes.

The zones are described as belonging to the brain that interfere in the process that has been called “reward system” by Dames Olds and Peter Milner (1954).

The last researches have shown that even if the nervous system has a high degree of plasticity, with improvement possibilities, the installed lesions during addiction type intake need a very long recovery period.

The majority of addicted do not quit because of organic need developed on drug intake but because the ritual of conditioning reflex added to it [7].

We would like to underline the long time effect over the vegetative-somatic functions that contribute to the slow decay of the organism. The lesions become more and more ample including the immune system. The most recognisable element in the dependency remains the emotional-behavioural disorders. It is known that drugs disorganise the social professional life leading to serious behavioural disorders (even suicide and criminality).

The necessity to procure the drug makes the individual become an isolated man capable of anything. From a domestic point of view especially environments of origin from disorganised families have been described. Genetically, although ample studies have been made, a pertinent conclusion could not be drawn although some psychologic types appear to be more vulnerable than others.

Those with mental illnesses like bipolar psychosis, depression of even schizophrenia make up a special category where drug dependance may appear. The medical aspects of the consumption of drugs...
include: somnolence followed by coma; disarthrya, walking disturbances; attention disorders; miosis followed by midriasis [8,9].

The withdrawl is characterised by fever; cardio-vascular modifications tahycardia, arterial tension variance, hipothermia, sweating, gastrointestinal disorders (nausea, vomiting, diareea), bilateral midriasis, anxiety, insomnia, instability, depresion. Drug dependancy reduces the quality of life through its effects on the body and the complications arousing after their use. Of those we underline: infectious (local because of precarious hygiene) general (TBS, hepatites BCDta, sexual, the HIV virus, siphilis) physic (depression almost 60% of consumers)

**Clinical symptoms of drug abuse:**

**Heroin:** somatic (nausea, vomiting, constipation, variations of the arterial tension and cardiac frequency, hipothermia) neurologic (disarthrya, miosis) psychic (euphoria, somnolence or coma at overdose, depression even suicide, behavioural disorders of impulsive or even antisocial type, professional and family abandon),

**Cocain:** somatic (hypertension, haemorrhage, miocardial infarction, intestinal infarction, shock, sudden death abortion) nervous (headache, convulsions, cerebral infarction or haemorrhage, coma) psychic (depressions and anxiety, manic disturbances, paranoia, delerium, halucinations, tendencies to combine drugs),

**Fenciclidin** (effects similar to cocain): somatic (hypo or hypertension, miopathy); nevous (involuntary movements distonia, diskinesis), psychic (delerium, agitation, violence, halucinations bizarre behaviour, anxiety).

Fig. 4. Cerebral atrophy in CT examination at 29 years old patient (drugs addiction)
**Amphetamines** (similar to cocaine): somatic (tachycardia, variations of the arterial tension, arrhythmias, sweating, nausea, vomiting, muscle weakness, respiratory disorders) nervous (comatose crises) psychic (confusion, psychotic states of mine some can last for years after ending of consumption, great liability),

**Cannabis**: somatic (tachycardia, hypothermia, myocardial ischemia) nervous (modifications of the EEG, disturbances of sleep–REM type) psychic (delerious ideas, hallucinations, anxiety),

**Hallucinogenes** (L.S.D.-Mescaline): somatic (tachycardia, miosis, sweating); nervous (tremor, disorders of motor coordination) psychic (anxiety, depression, illusions, nonpersonalize, nonrealistic).

**Some principles of prevention and treatment of drug abuse**

The fight against drug abuse is a state policy. The state, via specialised organisms fights permanently to anihilate the activities of drug delers. The mens of fighting also include informing at different community levels (schools, clubs) at mass-media level or even in the relationships with parents and teachers [10,11,12].

Medical treatment, in the case of drug abuse concerns:
1. Saving the life, in the case of acute intoxications (first time or overdose)
2. Treatment in the time of withdrawal of detoxification

In withdrawal detoxification is achieved using agonists, which have both reduced effects on nervous system and while the consequences of addiction (eg methadone administration in case of heroin addiction). Psichotherapies make up for the most efficient way of treatment associated to the detoxifying period and for the prevention of relapses.

**Imagistic cerebroventricular aspects at the drug users**

Cerebral atrophy represents an irreversable shrinkige of the tissue volume of the brain; it is usually followed by the reduction of the intelectual capacity until total dementia is installed. Although a cerebral atrophy exists with the coming of age, the greater part of cerebral atrophies come with degenerative diseases of the brain [13,14,15].

Cerebral atrophy is of two kinds: focal and diffuse. Focal cerebral atrophy is met in diseases like: vascular accidents, cerebral posttraumatic contusions, cerebral inflammatory affections or chronic degenerative illnesses like Alzheimer’s of Huntington’s.

We usually detect diffuse cerebral atrophy in the elderly or a multitude of other causes such as evolutive dementias (Alzheimer’s disease, Pick disease, vascular dementias, Parkinson’s, MS, alchoholism, drug abuse).

Regarding the diagnostic of cerebral atrophy, it is put based on the clinical symptoms and imagistic investigationes – CT scannig and cerebro-ventricular M.R.I [16]. In computer tomographic images of cerebral atrophies one can notice hypodense areas concerning both white and grey matter. According to the lenght of these areas and their localisation the retractile effect on the ventricular system or formations near it can be noticed [17].

In the case of diffuse cerebral atrophy – both at the CT exam and at the M.R.I. exam we can notice the enlargement of the cortical ditches, the silvian valleys, the interemispheric fissure without the dilatation of the ventricles [18, 19].

Also subcortical atrophy is characterised by the shrinkage of the volume of the central grey nuclei, the enlargement of the ventricular system, without any important enlargement of the cortical ditches and the cistern at the base of the brain. It has been noticed that the brain of the man atrophies faster with the coming of age. The M.R.I. exam has shown that with age men present an increase with 30% of the cephalorahidian liquid, as opposed to 1% in women.
References